

III. FACTORS AFFECTING UNEMPLOYMENT IN 1993

INTRODUCTION

In this section data are examined to determine the relationship of demographic and career-related factors to unemployment in the doctoral science and engineering population.¹⁶ The demographic variables examined include: sex; family status; race/ethnicity; place of birth; disability status; and age/time since completion of degree.

Several career-related variables that are at least partly under an individual's control are also examined in this section. Two of these variables—field of degree and age upon completing the doctoral degree—are related to educational choice. Three variables examined are measures of different aspects of prior work experience—years of full-time work experience, years of part-time work experience, and whether the individual was employed in April 1988. The final three variables pertain to other aspects of employment among those working in 1988—employment sector, location, and occupation.

DEMOGRAPHIC FACTORS

Race/Ethnicity

According to a Department of Labor report, “Jobless rates among black workers have consistently been 2 to 2.5 times that for whites. Persons of Hispanic ethnicity have generally fared somewhat better than blacks, though they also experience higher rates of joblessness than whites.”¹⁷ The Department of Labor attributes this association between race/ethnicity and unemployment only partially to the lower educational levels of blacks and Hispanics.¹⁸ However, among individuals with doctoral degrees in science and engineering fields, race/ethnicity does not appear to affect substantially the likelihood of being unemployed. The unemployment rate for non-Hispanic blacks in 1993 was 1.4 percent; for Hispanics of all races it was 1.9 percent, compared to the 1.6 percent rate for non-Hispanic whites. These differences were not statistically significant. The overall association between

race/ethnicity and unemployment also was not statistically significant when controlling for the other variables in the analysis.¹⁹

Gender and Family Status

Gender

In 1993, women doctoral scientists and engineers had a slightly higher unemployment rate than men (1.8 percent compared to 1.6 percent), but the difference was not statistically significant.²⁰ A multivariate analysis confirmed the lack of a statistically significant relationship between gender and unemployment status in 1993, when other relevant factors were controlled.²¹

Family Status and Gender

In the general population, marriage and children are associated with low unemployment rates.²² A similar pattern existed in the 1993 doctoral science and engineering population. However, the impact of marriage and children is quite different for men and women in the doctoral population.

Single men have a higher rate of unemployment than married men, but the same is not true for women (table 1). The unemployment rate for married men was 1.3 percent, compared to 2.8 percent for unmarried men. The comparable unemployment rates for women were 1.9 percent and 1.6 percent, respectively. Standardization did not change these relationships.

¹⁹ While the main effect of race/ethnicity was not statistically significant, there were some statistically significant interaction effects noted. These are discussed in Appendix B.

²⁰ All tests of significance used in this report are approximate and calculated at the .05 level. See the Technical Notes for more information on these tests.

²¹ After determining that the main effect of gender on unemployment was not significant, interaction effects between gender and family status variables were introduced into the model and found to be significant. The statistical techniques are discussed in the Technical Notes.

²² In 1993, the unemployment rate for married men was 4.4 percent, compared to 7.1 percent for men in the total population. U.S. Department of Labor, p. 186. In 1980, married men had an unemployment rate of 4.2 percent, compared to a total unemployment rate for all men of 6.9 percent. For women, the comparable rates were 5.8 percent and 7.4 percent. Bureau of Labor Statistics, p. A-13.

¹⁶ Information on some additional variables is included in the Technical Notes and Appendix Tables.

¹⁷ U.S. Department of Labor, p. 33.

¹⁸ *Idem*.

Table 1. Unemployment rates for doctoral scientists and engineers, by marital status and gender: 1993

Marital status/gender	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate/1
		By Percent	
Married -- total.....	374,390	1.4 *	1.4
Men.....	311,980	1.3 *	1.3
Women.....	62,410	1.9	1.9
Not married -- total.....	96,110	2.4 *	2.4
Men.....	63,230	2.8 *	2.8
Women.....	32,880	1.6	1.6
All individuals.....	470,500	1.6	1.6

*Difference between unemployment rate observed in group and total unemployment rate excluding those in the group is statistically significant at .05 level.

¹ See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

The unemployment rate for individuals with children in the home (1.4 percent) was lower than the unemployment rate for those without children living in the home (1.9 percent) (table 2). Like marital status, having children produced significant differences in the unemployment rates of men and women. Although women with children had unemployment rates exceeding those for women without children (2.4 percent compared with 1.2 percent), men with children had lower unemployment rates than their childless counterparts (1.2 percent compared with 2.1 percent). Standardization on the non-demographic variables did not reduce significantly the strength of this interaction effect.

In order to determine if the impact of family status on unemployment was different for men and women in the general population, unemployment rates by sex and family status were calculated from Bureau of Labor Statistics data for March 1996. In the general population, the unemployment rates for both married women and men were below those for unmarried individuals. However, the difference in unemployment rates was more dramatic for men than for women. The unemployment rate for unmarried men was 8.7 percent, compared to 3.6 percent for married men; the

corresponding rates for women were 5.6 percent and 3.3 percent. As was true in the doctoral science and engineering population, the impact of children on unemployment within the general population was different for the two sexes. Men with children had relatively low unemployment rates compared with men without children (4.0 percent versus 5.5 percent); while for women, the unemployment rate for those with children was higher (4.5 percent compared to 3.8 percent).²³

Place of Birth

Pre-college educational experiences, among others, are important in shaping values, interests, and job-related skills that continue throughout a career. Unfortunately, it is not easy to develop valid measures of such characteristics for use in a large-scale survey. Since educational and other childhood experiences are likely to be affected by place of birth, this variable can be used as a rough indicator of such experiences.

The association between place of birth and the unemployment rate was statistically significant in the 1993 doctoral science and engineering population; however, the association was not particularly strong

²³ These figures were calculated using Ferret, an online database from the March 1996 Current Population Survey (<http://ferret.bls.census.gov/cgi-bin/ferret>). Unemployment rates were calculated for individuals aged 25–75.

Table 2. Unemployment rates for doctoral scientists and engineers, by gender and whether there are children in the home: 1993

Children in Home/Gender	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate ¹
		by Percent	
Children present -- total.....	252,700	1.4 *	1.6
Men.....	209,420	1.2 *	1.4
Women.....	43,280	2.4 *	2.6
Children not present -- total.....	217,800	1.9 *	1.8
Men.....	165,790	2.1 *	2.0
Women.....	52,010	1.2 *	1.2
All individuals.....	470,500	1.6	1.6

* Difference between unemployment rate observed in group and total unemployment rate excluding those in the group is statistically significant at .05 level.

¹ See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

(table 3). Perhaps most interesting is that the unemployment rate for those born outside the United States (2.0 percent) is somewhat higher than for those born in this country (1.5 percent). However, the association between place of birth and unemployment rate was not statistically significant when controls were made for other variables, including years from doctorate and field of degree—both of which are associated with being born in the United States²⁴ and are likely to be associated with place of birth within the United States.

Disability Status

Disability status was significantly related to the unemployment rate in the 1993 doctoral science and engineering population (table 4). Those who reported difficulty walking had a 3.4-percent unemployment rate; the rate was 3.6 percent for those with difficulty lifting and 3.0 percent for those with hearing disabilities—compared to the overall Ph.D. unemployment rate of 1.6 percent. However, those with difficulty seeing had an unemployment rate of 1.9 percent—only slightly above average. Since the incidence of disabilities increases with age, and unemployment rates tend to be higher in the older population, age can be expected to explain part of the observed difference. This

appears to be the case, although standardization does not eliminate the association between disability status and unemployment for individuals with disabilities other than vision.

Age and Time Since Completion of Degree

Unemployment rates in the doctoral science and engineering population increased steadily with age in 1993—from 1.1 percent for those under 35 to 4.2 percent for those 65 and older (chart 3). However, standardized values were not calculated for age, because time since completion of degree and age at the time of receiving the doctorate were included, and it is not possible to include all three variables in the same multivariate analysis.²⁵

An important factor in explaining the unemployment rate in 1993 was the elapse of time since completion of degree. However, the relationship was not linear (chart 4). Unemployment was highest at the extremes of the distribution. The unemployment rate was 3.0 percent for those who received degrees 10 or 11 months before the interview, and 2.2 percent for those

²⁴ See NSF 96-311.

²⁵ See the Technical Notes for further discussion of this point.

**Table 3. Unemployment rates for doctoral scientists and engineers,
by place of birth: 1993**

Region/State of Birth	Population Size	Actual Unemployment Rate -- by Percent
New England.....	26,480	1.4
Connecticut.....	6,360	1.3
Massachusetts.....	15,150	1.4
Other.....	4,960	1.4
Middle Atlantic.....	104,270	1.5
New Jersey.....	15,740	1.3
New York.....	59,990	1.7
Pennsylvania.....	28,540	1.4
East North Central.....	76,060	1.7
Illinois.....	26,640	1.8
Indiana.....	8,120	1.6
Michigan.....	13,380	1.5
Ohio.....	19,310	1.6
Wisconsin.....	8,620	2.3
West North Central.....	36,430	1.2 *
Minnesota.....	8,470	0.8 *
Missouri.....	8,830	1.0
Other.....	19,140	1.4
South Atlantic.....	37,210	1.0 *
District of Columbia.....	5,590	0.6 *
Florida.....	5,090	0.6 *
Maryland.....	5,050	1.7
North Carolina.....	5,310	2.3
Virginia.....	5,070	0.3 *
Other.....	11,100	0.8 *
East South Central.....	14,980	2.0
West South Central.....	26,490	1.8
Texas.....	14,870	1.5
Other.....	11,620	2.2
Mountain.....	16,380	2.1
Pacific.....	38,580	1.5
California.....	28,260	1.7
Washington.....	5,350	1.0
Other.....	4,980	1.0
Other.....	93,630	2.0 *
All individuals.....	470,500	1.6

* Difference between unemployment rate observed in geographic area and total unemployment rate excluding those in the group is statistically significant at .05 level.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

Table 4. Unemployment rates for doctoral scientists and engineers, by disability status: 1993

Disability status	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate ¹
		by Percent	
Not Disabled.....	446,760	1.6	1.6
Disabled:			
Disability related to seeing.....	8,290	1.9	1.6
Disability related to hearing.....	11,360	3.0 *	2.5
Disability related to walking.....	3,470	3.4	2.7
Disability related to lifting.....	4,860	3.6 *	2.5

* Difference between unemployment rate observed in disability status group and total unemployment rate excluding those in the disability status group is statistically significant at .05 level.

¹ See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

who received degrees 25 or more years ago.²⁶ Unemployment rates showed little difference among those who received degrees between 1 and 24 years; previously, these rates ranged from 1.3 percent to 1.7 percent.

An examination of the relationship between time since completion of the doctorate and the unemployment rate, controlling for the other variables in this analysis, confirmed that years since completion of the doctorate is an important determinant of unemployment. Indeed, this relationship is even stronger after controlling for the other variables in this analysis. The standardized unemployment rates ranged from 0.4 percent for those who received degrees between 10 months and 3 years prior to data collection to 4.5 percent for those who received degrees 30 years earlier. These standardized scores are calculated using the assumption that individuals have equal values on the variables in this analysis other than the one being examined. In this case, it is important to note that included in the control variables are years of full-time work experience and age at time of receiving the doctorate. Thus, unemployment rates rose with age (equal to age at receiving the doctorate plus years

since the doctorate) among those who were the same age at the time they graduated and who had the same number of years of work experience.

FACTORS RELEVANT FOR CAREER DECISIONS

Educational Decisions

Field of Degree

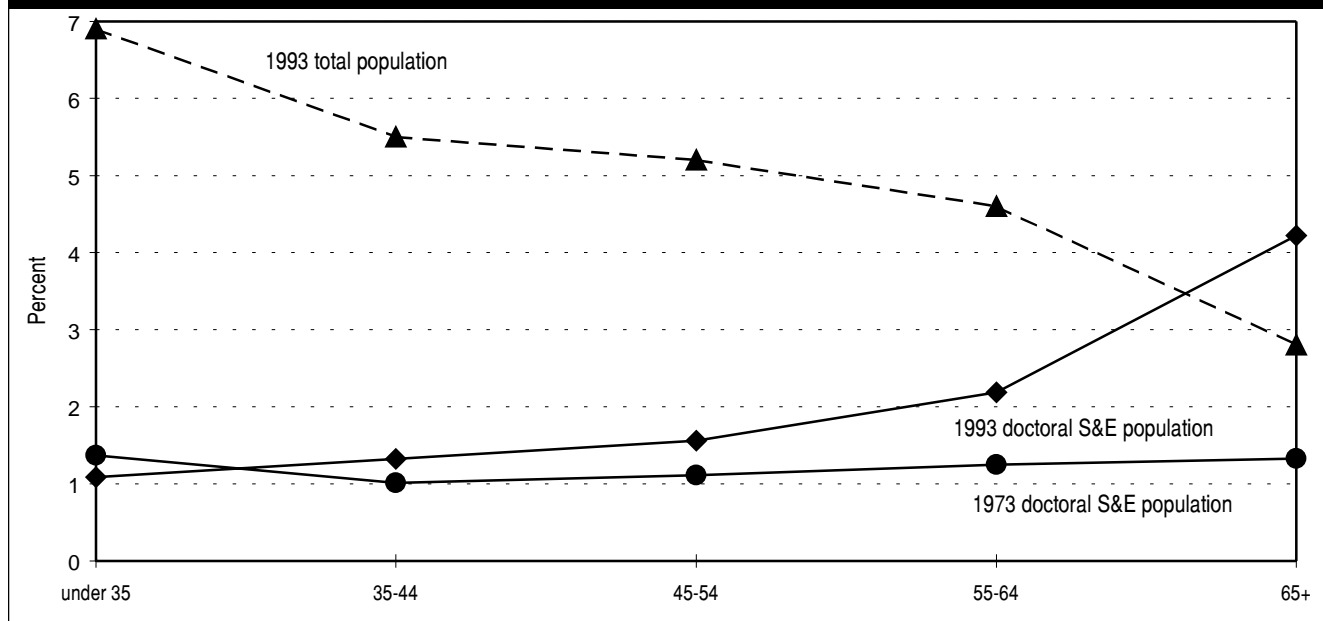
Unemployment rates vary significantly by degree field, according to data from the 1993 Survey of Doctorate Recipients (SDR) (table 5). Unemployment rates ranged from 0.6 percent in civil engineering to 2.5 percent in the geological and environmental sciences. However, there were no statistically significant differences among broad degree field categories of natural science and mathematics, social sciences, and engineering.

Standardized unemployment rates for field of degree indicate that controlling for other variables does not diminish the strength of the relationship between field of degree and unemployment.²⁷ The range for

²⁶ Note that 1993 graduates were not included in this sample; therefore, no information is available for those who received degrees fewer than 10 months earlier.

²⁷ See Text Box for brief explanation of standardization techniques used in this study and Technical Notes for more detailed explanation.

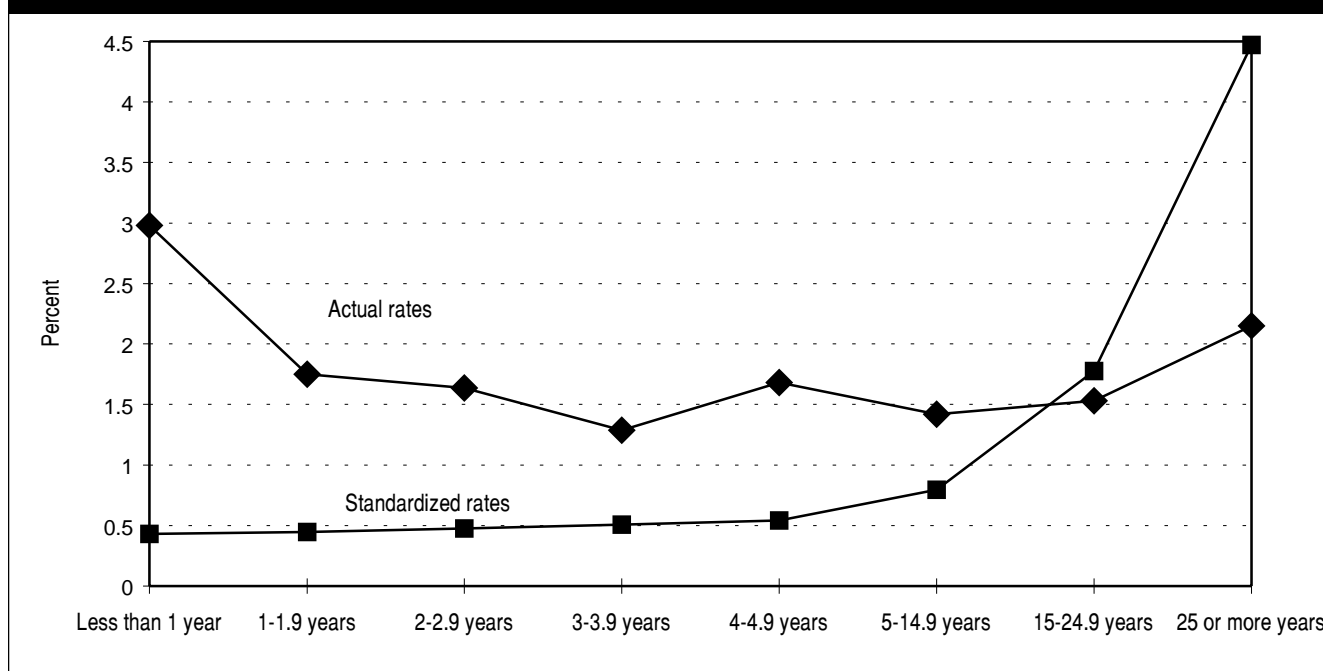
Chart 3: Unemployment rates of persons with doctoral degrees in science and engineering in 1973 and 1993 and in the total population in 1993, by age



NOTE: See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

SOURCES: Doctoral statistics from National Science Foundation/SRS, 1993 Survey of Doctorate Recipients. General population figures from Bureau of Labor Statistics, 1993 Current Population Survey.

Chart 4. Unemployment rates of persons with doctoral degrees in science and engineering, by year since doctorate: 1993



NOTE: See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

standardized unemployment rates is 0.5 to 2.4 percent. However, the magnitude of unemployment rates within some fields shift considerably when controlling for other variables.

What is more surprising than the existence of a statistically significant relationship between detailed degree field and unemployment rate is that the effect is not more dramatic. None of the rates approached those observed in the general population.

Age at Completing the Doctorate

Individuals planning to pursue doctorates face a number of decisions that affect the age at completing the doctorate. Individuals must decide whether to enroll

in graduate school immediately after completing their baccalaureate, to go directly to work, or to pursue other interests. In selecting a department, individuals may use information about the length of time it usually takes students in different departments to complete a degree. Further decisions affecting age at completing the degree are made after enrollment. For example, a student may consider pursuing a graduate degree on a part-time basis in order to have children. Of course, decisions under the individuals' control do not always determine the age at which the doctorate is received. Changes in academic requirements, the availability of financial resources, and personal problems (such as illness) also affect the age at completing the doctorate.

Table 5. Unemployment rates for doctoral scientists and engineers, by degree field: 1993

Degree Field	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate ¹
		by Percent	
Natural Sciences and Mathematics.....	254,240	1.7	1.6
Agricultural sciences.....	15,390	1.9	2.4
Biological sciences.....	107,180	1.4	1.5
Chemistry.....	52,710	1.8	1.2
Geological and environmental sciences....	16,770	2.5 *	2.4
Mathematical and computer sciences.....	28,260	1.1 *	1.2
Physics and astronomy.....	33,930	2.3 *	2.2
Social Sciences.....	138,690	1.4	1.7
Economics.....	19,690	1.4	2.0
Political science.....	14,580	2.0	2.2
Psychology.....	71,950	1.3 *	1.8
Sociology/Anthropology.....	20,110	1.6	1.3
Other social sciences.....	12,350	1.5	1.3
Engineering.....	76,440	1.7	1.5
Chemical engineering.....	11,340	1.8	1.5
Civil engineering.....	7,100	0.6 *	0.5
Electrical engineering.....	19,780	1.9	1.8
Mechanical engineering.....	9,560	1.0	0.9
Other engineering.....	28,650	2.1	1.6
All Fields**.....	470,500	1.6	1.6

* Difference between unemployment rate observed in field and total unemployment rate excluding those in the field is statistically significant at .05 level.

** The total includes individuals in fields not displayed because of small sample sizes.

¹ See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

Age at completing the doctorate has a statistically significant association with unemployment. For those receiving a doctorate before age 26, the unemployment rate was 1.2 percent; for those who were 40 or older, the rate was 3.7 percent (chart 5).

Calculating standardized unemployment rates indicates that the age at completing the doctoral degree is an even more important determinant of unemployment than was apparent from examination of the actual unemployment rates. Standardized unemployment rates ranged from 0.6 to 5.8 percent.

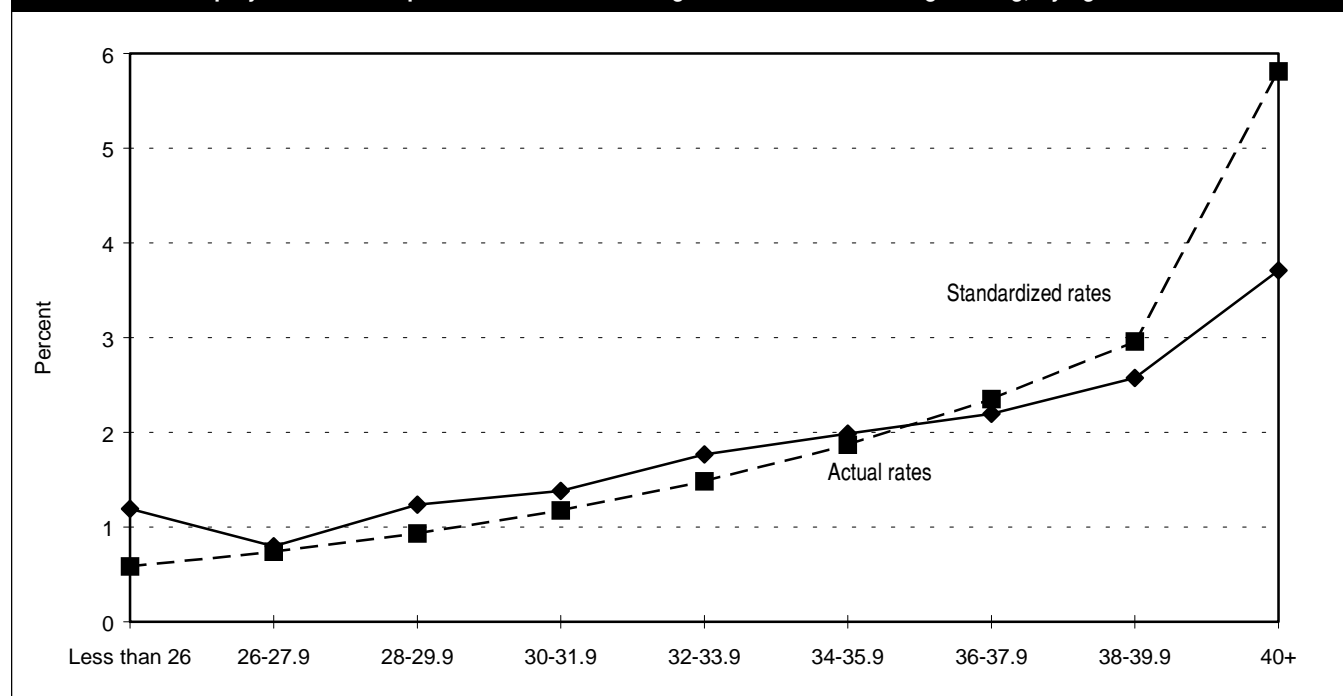
The fairly strong relationship between age at the time of receiving the doctorate and unemployment is not surprising, since receiving a doctorate at an early age can be an indicator of an individual's ability to get work done quickly and efficiently. It is, of course, not possible to determine whether the primary reason for this relationship is because potential employers are using age at completing the doctorate as a screening device or because those who complete their doctorates at a young age do indeed possess superior work skills. Also, no distinction is made in this analysis among

individuals with differing reasons for receiving their doctorates at above average ages. Additional exploration of this issue might, for example, point to differences between those who spent 12 years enrolled in graduate school and those who spent 7 years working prior to 5 years of graduate school. It should also be noted that individuals who receive their degrees later in life are older, on average, than individuals who receive their degrees at a younger age. The standardized rates do not fully control for this fact.

Amount of Work Experience

A variety of situations may cause an individual to consider voluntarily dropping out of the labor force or working part-time—including a desire to spend more time with young children or aging relatives, or simply taking time off to explore the world. There are also times when individuals need to choose between career paths offering different levels of job security. Careers may also be interrupted by factors beyond an individual's control. According to conventional wisdom, interruptions in full-time employment after completion of education can be harmful to an individual's future

Chart 5. Unemployment rates of persons with doctoral degrees in science and engineering, by age at doctorate: 1993



NOTE: See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

career. In this section, three basic indicators of career continuity—full-time work experience, prior period non-employment, and part-time work experience—are examined to determine how accurate this conventional wisdom is.

Full-time Work Experience

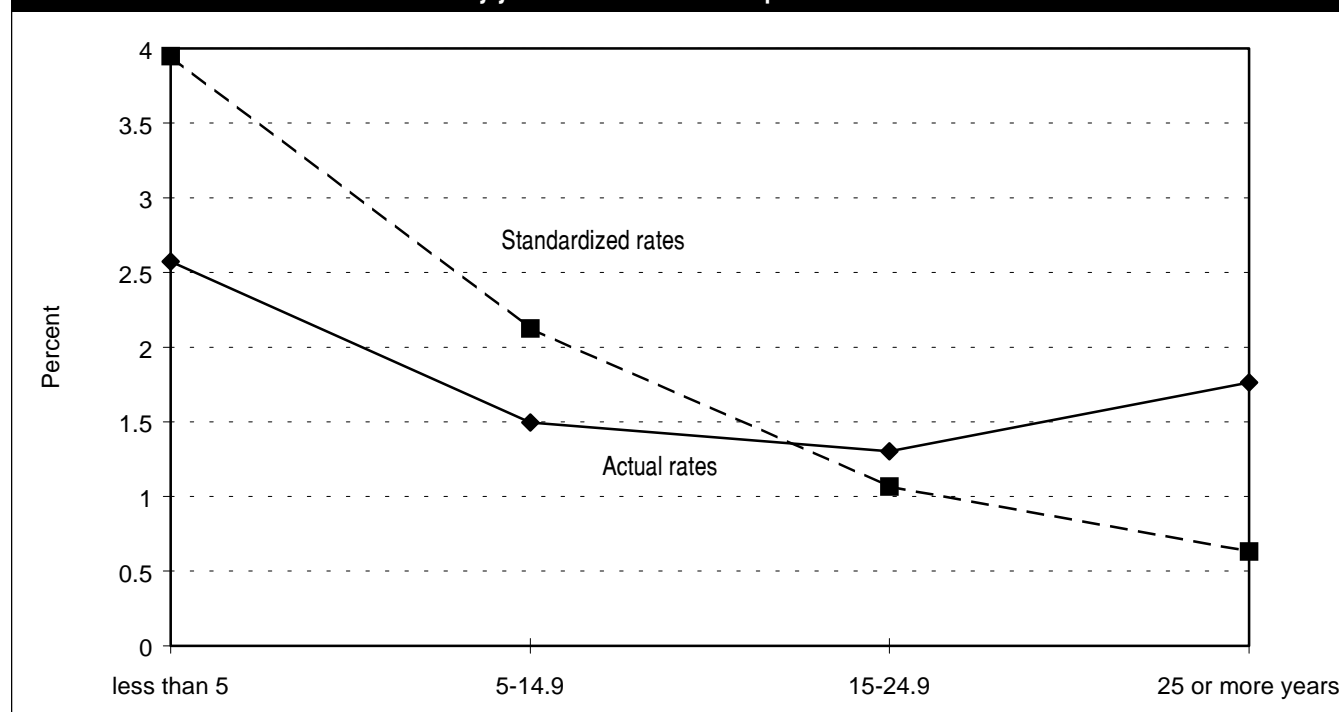
The unstandardized relationship between years of full-time work experience and unemployment is not linear (chart 6). Those with fewer than 5 years of experience and those with 25 or more years of full-time work experience were more likely to be unemployed than those with intermediate lengths of work experience. The unemployment rates among those with fewer than 5 years of full-time work experience were 2.6 percent; for those with 25 or more years, it was 1.8 percent. However, the unstandardized relationship does not take into account that the number of years of work experience is dependent upon the opportunity to work. For example, young workers have not had time to accumulate long work histories.

After controlling for other variables in this analysis, the relationship between full-time work experience and unemployment indicates that unemployment declines with increasing years of full-time work experience. The standardized unemployment rate for individuals with 2.5 years of full-time work experience was 3.9 percent, compared to 0.6 percent for those with 30 years of full-time experience. Therefore, among individuals completing their doctorates at the same time, the factor of additional years of full-time work experience appears to decrease the probability of unemployment. Because of the strong association between years since receipt of the doctorate and years of work experience, this relationship is obscured in looking at actual unemployment rates.

Prior Non-Employment

There are two factors that cause us to expect that prior period unemployment will lead to a higher probability of unemployment in the present. First, some of the factors that affect unemployment, such as age at

Chart 6. Unemployment rates of persons with doctoral degrees in science and engineering, by years of full-time work experience: 1993



NOTE: See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

receiving the doctorate, are permanent characteristics of the individual. Second, periods of prior unemployment are likely to be viewed negatively by prospective employers—at least partly due to the concern that scientific knowledge may be out-of-date after a period of unemployment. The variable in the 1993 SDR that most closely measures prior unemployment is the question on whether the respondent was employed in April 1988. Among those who were not employed in 1988, but were in the labor market in April 1993, the unemployment rate was 4.1 percent, compared to 1.5 percent for those who were employed in April 1988 (table 6).

Although the SDR does not permit differentiating between non-employment in 1988 associated with being unemployed and non-employment attributable to being out of the labor force, it is possible to calculate separate 1993 unemployment rates for individuals who received doctorates before 1988 and those who received them during or after 1988. For the latter group, unemployment rates did not differ significantly from those who were employed in 1988. However, among individuals who received doctorates before 1988, the unemployment rate was 9.6 percent, the highest rate observed in this study.

Table 6. Unemployment rates for doctoral scientists and engineers, by occupation in 1988: 1993

1988 Occupation	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate ¹
		by Percent	
Not employed in 1988.....	27,460	4.1 *	3.3
Post-1988 doctorates.....	19,090	1.6	1.7
Pre-1988 doctorates.....	8,370	9.6 *	6.8
Employed in 1988***	443,050	1.5 *	1.5
Science and engineering postsecondary teachers	116,200	0.7 **	0.6
Math/computer	16,560	0.6 **	0.8
Life	27,300	0.5 **	0.5
Physical	19,420	0.4 **	0.4
Social	38,320	1.0 **	0.8
Engineering.....	14,600	0.4 **	0.5
Other science and engineering occupations.....	202,580	1.9 **	2.1
Mathematical and computer	16,750	2.6 **	2.7
Agricultural	8,600	1.0	0.8
Biological	43,920	1.8	2.1
Chemists.....	22,030	2.9 **	4.8
Geologists and environmental	9,070	1.9	1.3
Physicists.....	14,600	2.3	1.9
Psychologists.....	1,540	0.6 **	0.4
Other social	34,080	1.4	1.1
Electrical	12,140	1.8	1.7
Other	9,440	2.5 **	3.1
Non-science and engineering occupations.....	30,430	1.5	1.4
Managerial and	35,670	1.3	1.4
Other non-science and	124,260	2.1 **	1.2
All individuals***	470,500	1.6	1.6

* Difference between observed unemployment rate and unemployment rate for total population, excluding those in category, is statistically significant at .05 level.

** Difference between observed unemployment rate and unemployment rate for employed population, excluding those in category, is statistically significant at .05 level.

*** The total includes individuals in categories not displayed because of small sample sizes.

¹ See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

² See the Technical Notes for an explanation of occupations included in this category.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

One reason for the high 1993 unemployment rate of those not employed in 1988 might be that many unemployed individuals have characteristics (such as age at degree and degree field) that predispose them to having high unemployment rates throughout their careers. Although the high unemployment rate for pre-1988 doctorates who were not employed in 1988 was reduced by controlling for the other variables in this analysis (from 9.6 to 6.8 percent), the standardized unemployment rate remains high relative to that for the doctoral population as a whole. It is likely that this association is at least partly explained by factors other than those measured in this study.

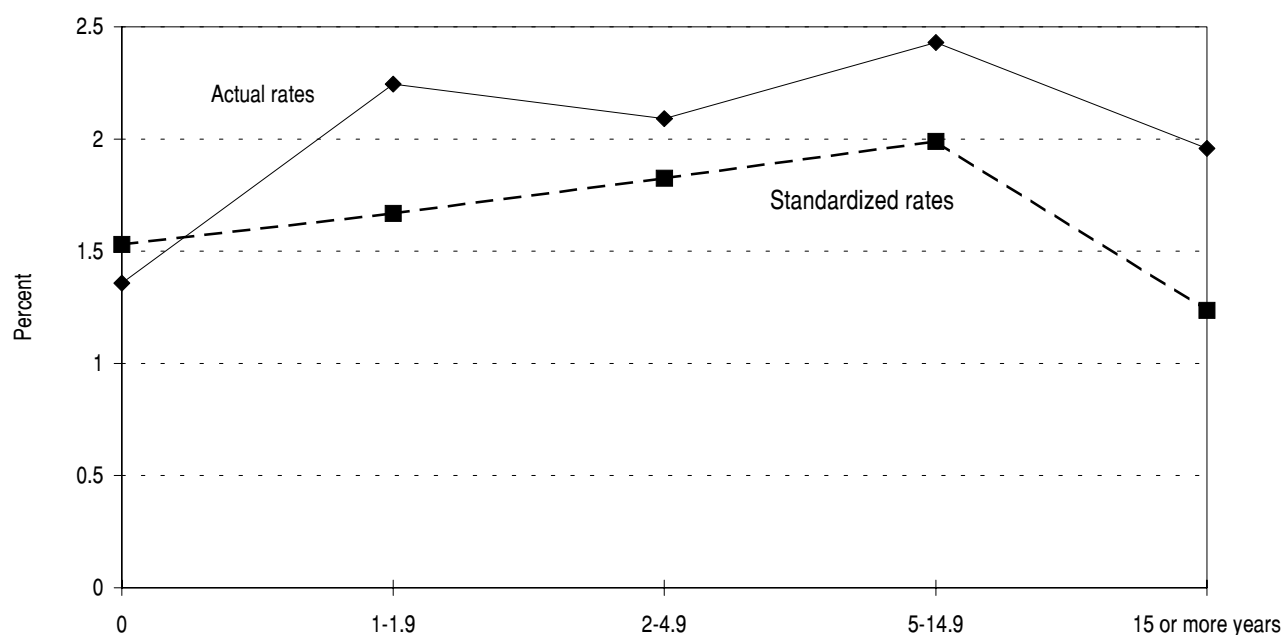
Part-Time Work Experience

Prior part-time employment, regardless of the number of years of work experience, appears to increase the likelihood of unemployment. Those with no part-time employment (70 percent of the total popula-

tion) had an unemployment rate of 1.4 percent; those with part-time employment had rates ranging from 2.0 to 2.4 percent (chart 7). Part-time employment may indicate a relatively low commitment to labor market participation that is viewed unfavorably by employers. However, it is also possible that the same factors that led to earlier part-time employment (for example, poor health, family responsibilities) may affect employability later.

There is a curvilinear relationship between standardized unemployment rates and years of part-time employment—those at the extremes of the distribution on part-time employment have the lowest unemployment rates. However, the relationship is weak—unemployment rates ranged from 1.2 to 2.0 percent. One plausible explanation is that the experience obtained from part-time employment is approximately balanced by the negative connotation of part-time versus full-time employment.

Chart 7. Unemployment rates of persons with doctoral degrees in science and engineering, by years of part-time work experience: 1993



NOTE: See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

Other Career Choices

Occupation

Occupation is widely recognized to affect employability. For example, in April 1993, the unemployment rate among individuals ages 16 and over within the U.S. population in managerial and professional specialty occupations was less than half that for all occupations—3.1 percent compared to 7.1 percent.²⁸

The unemployment rate in 1993 varied by the occupation held in 1988 (table 6). The observed rates ranged from under 0.4 percent for postsecondary teachers in the physical sciences and engineering to 2.9 percent for chemists. In general, those employed as postsecondary teachers in 1988 had lower unemployment rates than those employed in non-teaching occupations in allied fields. For example, among those employed as postsecondary teachers of mathematics or computer science in 1988, the unemployment rate was 0.6 percent, compared to 2.6 percent for other types of computer scientists or mathematicians. Among those not in the science and engineering professions, those who entered managerial

and professional specialty occupations were somewhat less likely to be unemployed—1.3 percent, compared to 2.1 percent for those who were in other non-S&E occupations in 1988.²⁹

The examination of standardized unemployment rates by occupation in 1988 confirms the importance of 1988 occupation in predicting 1993 unemployment rates. The difference between individuals who held positions as postsecondary teachers and non-postsecondary teachers in similar fields also remained after standardization. However, the difference in unemployment rates between those with employment in different types of non-S&E occupations in 1988 was eliminated by the controls. In other words, the apparent relationship was a function of other differences between the two groups.

Sector

The sector that employed the individual in 1988 had a fairly strong relationship with unemployment in 1993 (table 7). Among those who received degrees before 1988, the unemployment rate ranged from 0.6

Table 7. Unemployment rates for doctoral scientists and engineers, by employment sector in 1988: 1993

1988 Employment Sector	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate ¹
		by Percent	
Employed in 1988.....	443,050	1.5	1.5
Medical school.....	32,270	0.6 **	0.7
University-affiliated research institute.....	23,140	1.6	1.4
Other four-year college/university.....	169,710	1.1 **	1.0
Other educational employer.....	10,090	1.2	0.7
Private for profit employer.....	111,980	2.6 **	3.1
Self-employed -- incorporated.....	9,590	1.2	0.7
Self-employed -- not incorporated.....	19,740	1.0	0.4
Private not for profit employer.....	21,560	1.4	1.2
State government.....	8,240	0.8	0.6
U.S. government -- civilian position.....	27,980	1.0 **	1.0
Other employer.....	8,750	2.1	1.9
All individuals.....	470,500	1.6	1.6

* Difference between observed unemployment rate and unemployment rate for employed population, excluding those in category is statistically significant at .05 level.

¹See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.

²⁸ Bureau of Labor Statistics 1996.

²⁹ See the Technical Notes for an explanation of how this classification of non-S&E occupations was made.

percent for medical schools to 2.6 percent for private-for-profit institutions. In general, low unemployment rates were associated with employment in educational institutions in 1988 (ranging from 0.6 percent to 1.2 percent if university-affiliated research institutions are excluded). Employment with the Federal Government in a civilian capacity (1.0 percent) or with state government (0.8 percent) also resulted in low 1993 unemployment rates.

Examining the standardized relationship between type of 1988 employer and 1993 unemployment rate (among those who were employed in 1988) did not substantially change the findings about the relationship between these two variables.

Geographic Location

Geographic location of residence and work is another employment-related decision individuals make. Because unemployment is higher in some parts of the country than in others,³⁰ it is reasonable to expect that state or region of employment (or residence if the individual is not employed) is associated with the unemployment rate for doctoral scientists and engineers. This is, in fact, the case (table 8). Unemployment rates for doctoral scientists and engineers ranged from 0.3 percent in the less-populated states in the West North Central region (Iowa, North Dakota, South Dakota, Nebraska, and Kansas) to 2.8 percent in California. Standardization did not have a substantial impact on the relationship between state of residence/employment and unemployment—standardized unemployment rates by state ranged from 0.5 to 2.7 percent.

CONCLUSIONS

Differences in unemployment rates between men and women, among racial/ethnic minorities, and between those born in the United States and those born elsewhere were not statistically significant in this study's multivariate analysis. However, unemployment rates were higher than average among individuals with mobility and hearing disabilities and individuals who completed doctorates more than 25 years before the survey, after controlling for the other variables included in the study. Further, marriage and children were associated with higher than average unemployment rates for women, but lower than average unemployment rates for men. These results, it is important to emphasize, are based on an imperfect multivariate analysis that can support, but not prove, causal relations between variables.

The analysis indicates that among those who hold U.S. doctorates in science and engineering, not being employed or being employed only part-time for a period of time may negatively influence future employability. Occupation, sector of employment, and geographic location are related to the likelihood of becoming unemployed. The risk associated with these choices is small, however, compared to the risks for the general population. The highest standardized 1993 unemployment rate in these analyses was 6.8 percent for the approximately 8,000 individuals who were neither employed nor students in 1988.

³⁰ See, for example, NSF 1972, pp. 26–29 and p. 73.

**Table 8. Unemployment rates for doctoral scientists and engineers,
by location of employment¹: 1993**

Regional/State of Employment	Population Size	Actual Unemployment Rate	Standardized Unemployment Rate ²
		by Percent	
New England.....	36,760	1.4	1.4
Connecticut.....	7,610	1.2	1.3
Massachusetts.....	21,660	1.4	1.3
Other.....	7,490	1.5	1.9
Middle Atlantic.....	81,510	1.3 *	1.3
New Jersey.....	19,580	1.3	1.1
New York.....	39,590	1.2 *	1.2
Pennsylvania.....	22,340	1.6	1.7
East North Central.....	64,770	1.4	1.5
Illinois.....	19,380	1.2	1.2
Indiana.....	7,690	1.0	1.2
Michigan.....	13,180	1.3	1.4
Ohio.....	17,070	2.2	2.3
Wisconsin.....	7,450	0.5 *	0.6
West North Central.....	27,820	0.9 *	1.0
Minnesota.....	8,170	1.8	1.9
Missouri.....	8,030	0.7 *	0.9
Other.....	11,620	0.3 *	0.5
South Atlantic.....	88,480	1.3 *	1.4
District of Columbia.....	13,600	0.7 *	0.7
Florida.....	12,060	2.4	2.4
Maryland.....	18,760	2.0	1.8
North Carolina.....	12,420	1.6	1.9
Virginia.....	13,830	0.9 *	0.9
Other.....	17,800	0.6 *	0.7
East South Central.....	19,200	1.1 *	1.2
West South Central.....	37,960	1.8	1.8
Texas.....	26,390	2.0	2.0
Other.....	11,560	1.3	1.6
Mountain.....	30,190	2.6 *	2.7
Pacific.....	82,120	2.5 *	2.3
California.....	62,230	2.8 *	2.5
Washington.....	10,780	1.9	1.8
Other.....	9,110	1.1	1.1
Other.....	1,700	1.1	1.0
All individuals.....	471,000	1.6	1.6

* Difference between unemployment rate observed in geographic area and total unemployment rate excluding those in the geographic area is statistically significant at .05 level.

¹ Unemployed individuals are classified by the location of their residence.

² See the Technical Notes for an explanation of the adjustment methodology used in calculating standardized unemployment rates.

NOTE: Detail may not add to total because of rounding.

SOURCE: National Science Foundation/SRS, 1993 Survey of Doctorate Recipients.